

SAFETY DATA SHEET

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product identifier:

VANADIUM ELECTROLYTE SOLUTION

1.2. Relevant identified uses of the substance or mixture and uses advised against:

Electrolyte solution for research and industrial use (vanadium redox flow batteries)

1.3. Details of the supplier of the safety data sheet:

Enerox GmbH

Industriezentrum NÖ-Süd, Straße 3, Objekt M36

2355 Wr. Neudorf, Austria

Tel.: + 43 2236 379 000 0

Fax: + 43 2236 379 000 9

1.3.1. Responsible person:

Ing. Peter Pokorny

E-mail:

peter.pokorny@gildemeister.com

1.4. Emergency telephone number:

+ 43 2236 379 000 512 during office hours

Vergiftungsinformationszentrale (Österreich)+43 1 406 43 43

Alberta 1-800-332-1414

in Calgary, outside of Alberta (403) 944-1414

United Kingdom 111

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008 [CLP]

Acute tox. 4, H302

Skin corr. 1A, H314

2.2. Label elements

Labelling according to Regulation (EC) No 1272/2008 [CLP]

Hazard pictograms



GHS05

GHS07

Signal word: **Danger**

Hazardous ingredients:

Divanadiumtris-(sulphate)

Vanadium oxide sulphate

Sulphuric acid

Phosphoric acid

Hazard statements

H302 Harmful if swallowed.

H314 Causes severe skin burns and eye damage.

Precautionary statements

P280 Wear protective gloves/protective clothing/eye protection/face protection.

P303+P361+P353 IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.

P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P312 Call a POISON CENTER or doctor/physician if you feel unwell.

P301+P330+P331 IF SWALLOWED: rinse mouth. Do NOT induce vomiting.

P403+P233 Store in a well-ventilated place. Keep container tightly closed.
 P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

2.3. Other hazards

No other known specific hazards for human or environment.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1. Mixture:

Description	CAS number:	EU number	REACH reg. nr.	Conc. (%)	Classification				
					REACH		CLP		
					Hazard symbol	R phrase	Hazard pict.	Hazard cat.	H phrase
Divanadiumtris-(sulphate)	13701-70-7	237-226-6	*	=<15	Xn	22-36/37/38	GHS07 Warning	Acute tox. 4 Skin Irrit. 2 Eye irrit. 2 STOT SE 3	H302 H315 H319 H335
Vanadium oxide sulphate	27774-13-6	248-652-7	*	=<15	Xn, Xi	22-36/37/38	GHS07 Warning	Acute tox. 4 Skin Irrit. 2 Eye irrit. 2 STOT SE 3	H302 H315 H319 H335
Sulphuric acid	7664-93-9	231-639-5	01-2119458838-20-0148	~15	C	35	GHS05 Danger	Skin corr. 1A	H314
Phosphoric acid	7664-38-2	231-633-2	*	<1	C	34	GHS05 Danger	Skin corr. 1B	H314
Water	7732-18-5	231-791-2	-	balance	-	-	-	-	-

* Substance currently below current REACH registration limit.

SECTION 4: FIRST AID MEASURES

4.1. Description of first aid measures:

IN CASE OF INGESTION:

- Measures: - Obtain immediate medical attention and show him the label!
 - Place the victim into comfortable position!
 - Do not give the victim anything to eat or drink, and do not induce vomiting if the victim is unconscious.
 - In case of vomiting turn the head down of the injured person.

IN CASE OF INHALATION:

- Measures: - Take the victim into fresh air, loosen his clothes and let him rest.
 - If necessary, administer artificial respiration!
 - Obtain immediate medical attention and show him the label!

IN CASE OF SKIN CONTACT:

- Measures: - Remove the contaminated clothes.
 - Wash the contaminated area with plenty of warm water and soap (for 15 minutes)!
 - In case of symptoms, obtain medical attention and show him the label!

IN CASE OF EYE CONTACT:

- Measures: - In case of contact with eyes flush immediately with plenty of flowing water holding eyelids apart (for at least 15 minutes).
 - In case of persistent symptoms, call a physician.

4.2. Most important symptoms and effects, both acute and delayed:

No data available.

4.3. Indication of any immediate medical attention and special treatment needed

No data available.

SECTION 5: FIREFIGHTING MEASURES

5.1. Extinguishing media:

5.1.1. Suitable extinguishing media:

Water fog, foam, dry chemical, carbon dioxide.

5.1.2. Unsuitable extinguishing media:

None known.

5.2. Special hazards arising from the substance or mixture:

The formation of dangerous decomposition products greatly depends on the circumstances of the combustion. A complex mixture of airborne solid, liquid and gas substances may occur, such as carbon monoxide, carbon dioxide, sulphur dioxide (SO₂), sulphur trioxide (SO₃) or SO₃ mist

5.3. Advice for firefighters:

Wear full protective clothing and self-contained breathing apparatus. Dispose of fire debris and contaminated fire fighting water in accordance with official regulations.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures:

6.1.1. For non-emergency personnel:

Keep unprotected people away, allow only well-trained experts wearing suitable protective clothing to abide in the field of accident.

6.1.2. For emergency responders:

None known.

6.2. Environmental precautions:

Dispose of spillage and waste (product/packaging) in accordance with all applicable environmental laws. Do not allow to enter sewers/soil/surface or ground water. Notify the respective authorities in accordance with local law in the case of environmental pollution immediately.

6.3. Methods and material for containment and cleaning up:

Collect the spilled material with non-combustible absorbent, then place into a suitable, closed, properly labelled chemical waste container for disposal. During disposal wear suitable personal protective equipment. Do NOT attempt to neutralise with chalk, lime or similar substances (strong exothermic reaction).

6.4. Reference to other sections:

For further and detailed information see section 8 and 13.

SECTION 7: HANDLING AND STORAGE

7.1. Precautions for safe handling:

Precautions for safe handling:

Observe conventional hygiene precautions.

Technical measures:

Ensure adequate ventilation!

Precautions against fire and explosion:

No specific prescription.

7.2. Conditions for safe storage, including any incompatibilities:

Technical measures and storage condition:

Keep in original, tightly closed and labelled container.

The place of storage has to be properly ventilated and cleanable.

Follow all instructions on the label.

Incompatible materials: bases and alkalis, avoid contact with metals

Packaging material: original packaging.

7.3. Specific end use(s):

Vanadium redox flow batteries.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters:

Sulphuric acid (CAS number: 7664-93-9)					
Country	Limit 8 Hours		Short-term limit		Legal notice
	ppm	mg/m ³	ppm	mg/m ³	
Austria		0,1 E		0,2 E	GKV 2011
EU		0,05			
Canada, Alberta		1			OCCUPATIONAL HEALTH AND SAFETY CODE
Australia		1		3	Workplace Exposure Standards for Airborne Contaminants
USA		1			NIOSH Pocket Guide, 2011
United Kingdom		(1)			EH40/2005 Workplace exposure limits

E = respirable fraction

() The UK Advisory Committee on Toxic Substances has expressed concern that, for the OELs shown in parentheses, health may not be adequately protected because of doubts that the limit was not soundly-based. These OELs were included in the published UK 2002 list and its 2003 supplement, but are omitted from the published 2005 list.

8.2. Exposure controls:

In case of a hazardous material with no controlled concentration limit it is the employer's duty to keep concentration levels down to a minimum achievable by existing scientific and technological means, where the hazardous substance poses no harm to workers.

8.2.1. Appropriate engineering controls

In pursuance of work is proper foresight needed to avoid spilling onto clothes and floors and to avoid contact with eyes and skin.

Ensure adequate ventilation.

8.2.2. Individual protection measures, such as personal protective equipment:

1. Eye/face protection: use appropriate protective goggles.



Tightly sealed goggles

2. Skin protection:

- a. Hand protection: use appropriate protective gloves.



Protective gloves:

Butyl rubber, BR or Nitrile butyl rubber, NBR: Value for the permeation: Level ≥ 480 min. (EN 374)

- b. Other: use appropriate acid-resistant protective clothes.

3. Respiratory protection: use respirator with adequate filter (only required in the event of aerosol or mist formation).

4. Thermal hazard: None known.

8.2.3. Environmental exposure controls:

No specific prescription.

The requirements detailed in Section 8 assume skilled work under normal conditions and usage of the product for appropriate aims. If conditions differ from normal or work is carried out under extreme conditions an expert's advice should be sought out before deciding upon further protective measures.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES:

9.1. Information on basic physical and chemical properties:

Parameter	Value	Test method:	Remarks:
1. Appearance:	Liquid, blue-green colour		
2. Odour:	no data available.		
3. Odour threshold:	no data available.		
4. pH value:	0 - 1		
5. Melting point/ freezing point:	$< 0^{\circ}\text{C}$		salt crystallisation may occur at an earlier stage
6. Initial boiling point/boiling range:	$> 100^{\circ}\text{C}$		in case of heating V_2O_5 may be formed.
7. Flash point:	not applicable.		
8. Evaporation rate:	no data available.		
9. Flammability:	non flammable.		
10. Upper/lower flammability or explosive limits:	not applicable		
11. Vapour pressure:	no data available.		
12. Relative density:	$1.3 - 1.4 \text{ g/cm}^3$		
13. Solubility(ies):	fully miscible with water		
14. Partition coefficient: n-octanol/water:	no data available.		
15. Self-ignition temperature:	not applicable.		
16. Degradation temperature:	no data available.		
17. Viscosity:	no data available.		
18. Explosive properties:	no data available.		
19. Oxidizing properties:	None		

9.2. Other information:

No further relevant information

SECTION 10: STABILITY AND REACTIVITY

10.1. Reactivity:

None known.

10.2. Chemical stability:

At normal temperature: stabile at general conditions of work.

10.3. Possibility of hazardous reactions:

None known.

10.4. Conditions to avoid:

None known.

10.5. Incompatible materials:

Alkalis (e.g. chalk, lime, sodium hydroxide, etc.), keep away from metals.

10.6. Hazardous decomposition products:

Sulphur-oxides (SO_x)

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects:

Acute toxicity: harmful if swallowed.

Corrosivity: Causes severe burns.

Sensitisation: none known.

Repeated dose toxicity: none known.

Carcenogenity: none known.

Mutagenicity: none known.

Reproduction toxicity: none known.

11.1.1. For substances subject to registration, brief summaries of the information derived from the test conducted:

No data available.

11.1.2. Relevant toxicological properties of the hazardous substances:

7664-93-9 Sulphuric acid	
Oral	LD50 2140 mg/kg (Rat) IUCLID
Inhalative	LC50/2h 510 mg/m ³ (Rat) IUCLID
27774-13-6 Vanadium(IV)oxysulphate	
Oral	LD50 448 mg/kg (rat)
Dermal	LD50 4450 mg/kg (rabbit)

11.1.3. Information on likely routes of exposure:

Ingestion, inhalation, skin and eye contact.

11.1.4. Symptoms related to the physical, chemical and toxicological characteristics:

No data available.

11.1.5. Delayed and immediate effects as well as chronic effects from short and long-term exposure:

Causes severe burns.

Harmful if swallowed.

11.1.6. Interactive effects:

No data available.

11.1.7. Absence of specific data:

No information.

11.1.8. Other information:

No data available.

SECTION 12: ECOLOGICAL INFORMATION

12.1. Toxicity:

Aquatic toxicity

7664-93-9 Sulphuric acid	
EC50 (24h)	29 mg/l (Daphnia)
LC50 (96h)	16-28 mg/l (Fish) (Lepomis macrochirus)
27774-13-6 Vanadium(IV)oxysulphate	
LC50 (96h)	6 mg/l (Fish)

12.2. Persistence and degradability:

No data available.

12.3. Bioaccumulative potential:

No data available.

12.4. Mobility in soil:

No data available.

12.5. Results of PBT and vPvB assessment:

No data available.

12.6. Other adverse effects:

No data available.

General statement:

Not let it go into groundwater, waterbodies or the sewerage

SECTION 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods:

Disposal according to the local regulations.

13.1.1. Information regarding the disposal of the product:

No special recommendation from the manufacturer.

During the disposal of the product, its residue and its packaging the national and local prescriptions should be observed.
The EWC codes indicated below are only recommendations, but they may have to be changed due to special circumstances, in such cases new classification may be needed.

EWC code 06 03 99

13.1.2. Information regarding the disposal of the packaging:

According to the consideration regarding the product.

13.1.3. Physical/chemical properties that may affect waste treatment options shall be specified:

None known.

13.1.4. Sewage disposal:

Dispose via the sewage system is to be discouraged.

13.1.5. Special precautions for any recommended waste treatment:

No data available.

SECTION 14: TRANSPORT INFORMATION

14.1. Land transport ADR/RID (cross-border)



· ADR/RID class: 8 Corrosive substances.

· Danger code (Kemler): 8

Product name: Vanadium-Electrolyte-Solution

· UN-Number: 3264

· Packaging group: II

· Hazard label: 8

· UN proper shipping name: CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S. (Vanadium-Electrolyte-Solution)

14.2. Maritime transport IMDG:



· IMDG Class: 8

· UN Number: 3264

· Label 8

· Packaging group: II

· EMS Number: F-A,S-B

· Proper shipping name: CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S. (Vanadium-Electrolyte-Solution)



- ICAO/IATA Class: 8
- UN/ID Number: 3264
- Label 8
- Packaging group: II
- Proper shipping name: CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S. (Vanadium-Electrolyte-Solution)

SECTION 15: REGULATORY INFORMATION

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

REGULATION (EC) No 1907/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC

COMMISSION REGULATION (EC) No 790/2009 of 10 August 2009 amending, for the purposes of its adaptation to technical and scientific progress, Regulation (EC) No 1272/2008 of the European Parliament and of the Council on classification, labelling and packaging of substances and mixtures

DIRECTIVE 1999/45/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 31 May 1999 concerning the approximation of the laws, regulations and administrative provisions of the Member States relating to the classification, packaging and labelling of dangerous preparations

REGULATION (EC) No 1272/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006

COMMISSION REGULATION (EU) No 453/2010 of 20 May 2010 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

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· **Section 355 (extremely hazardous substances):**

7664-93-9 Sulphuric acid

· **Section 313 (Specific toxic chemical listings):**

27774-13-6 Vanadium oxide sulphate

7664-93-9 Sulphuric acid

7664-38-2 phosphoric acid

· **TSCA (Toxic Substances Control Act):**

27774-13-6 Vanadium oxide sulphate

13701-70-7 Divanadium tris(sulphate)

7664-93-9 Sulphuric acid

7664-38-2 phosphoric acid

· **Proposition 65**

· **Chemicals known to cause cancer:**

None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity to females:**

None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for males:**

None of the ingredients is listed.

· **Chemicals known to cause developmental toxicity:**

None of the ingredients is listed.

· **Carcinogenicity categories**

· **EPA (Environmental Protection Agency)**

None of the ingredients is listed.

· **IARC (International Agency for Research on Cancer)**

7664-93-9 Sulphuric acid 1

· **NTP (National Toxicology Program)**

7664-93-9 Sulphuric acid K
· **TLV (Threshold Limit Value established by ACGIH)**
7664-93-9 Sulphuric acid A2
· **NIOSH-Ca (National Institute for Occupational Safety and Health)**
None of the ingredients is listed.
· **OSHA-Ca (Occupational Safety and Health Administration)**
None of the ingredients is listed.
· **European Inventory of Existing Commercial chemical Substances (EINECS)**
27774-13-6 Vanadium oxide sulphate
13701-70-7 Divanadium tris(sulphate)
7664-93-9 Sulphuric acid
7664-38-2 phosphoric acid
· **Canadian substance listings:**
· **Canadian Domestic Substances List (DSL)**
27774-13-6 Vanadium oxide sulphate
7664-93-9 Sulphuric acid
7664-38-2 phosphoric acid
· **Canadian Ingredient Disclosure list (limit 0.1%)**
None of the ingredients is listed.
· **Canadian Ingredient Disclosure list (limit 1%)**
27774-13-6 Vanadium oxide sulphate
7664-93-9 Sulphuric acid
· **Philippines Inventory of Chemicals and Chemical Substances**
27774-13-6 Vanadium oxide sulphate
7664-93-9 Sulphuric acid
7664-38-2 phosphoric acid
· **Chinese Chemical Inventory of Existing Chemical Substances**
27774-13-6 Vanadium oxide sulphate
7664-93-9 Sulphuric acid
7664-38-2 phosphoric acid
· **Australian Inventory of Chemical Substances**
27774-13-6 Vanadium oxide sulphate
7664-93-9 Sulphuric acid
7664-38-2 phosphoric acid

15.2. Chemical safety assessment: -
A Chemical Safety Assessment has not been carried out.

SECTION 16: OTHER INFORMATION

Information regarding the revision of the safety data sheet: -
Full text of the abbreviations in the safety data sheet:
DNEL: Derived no effect level. PNEC: Predicted no effect concentration. CMR effects: Carcinogenicity, Mutagenicity and reproduction toxicity. PBT: Persistent, bioaccumulative and toxic. n.d.: not defined. n.a.: Not applicable.
Data sources: -
Relevant R-Phrases (number and full text) of Section 2 and 3:
R 22 - Harmful if swallowed.
R 34 - Causes burns.
R 35 - Causes severe burns.
R 36/37/38 - Irritating to eyes, respiratory system and skin.
Relevant H-Phrases (number and full text) of Section 2 and 3:
H302 - Harmful if swallowed.
H314 - Causes severe skin burns and eye damage.
H315 - Causes skin irritation.
H319 - Causes serious eye irritation.
H335 - May cause respiratory irritation.
Training instructions: -
Recommended restrictions on use (non-statutory recommendations by supplier): -

Abbreviations and acronyms:

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
RID: Règlement international concernant le transport des marchandises dangereuses par chemin de fer (Regulations Concerning the International Transport of Dangerous Goods by Rail)

IMDG: International Maritime Code for Dangerous Goods
IATA: International Air Transport Association
IATA-DGR: Dangerous Goods Regulations by the "International Air Transport Association" (IATA)
ICAO: International Civil Aviation Organization
ICAO-TI: Technical Instructions by the "International Civil Aviation Organization" (ICAO)
GHS: Globally Harmonized System of Classification and Labelling of Chemicals
ACGIH: American Conference of Governmental Industrial Hygienists
EINECS: European Inventory of Existing Commercial Chemical Substances
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
EC50: Effective concentration, 50 percent

This safety data sheet had been prepared on the basis of information provided by the manufacturer. The information, data and recommendations contained herein are provided in good faith, obtained from reliable sources and believed to be true and accurate as of the date issued; however, no representation is made as to the comprehensiveness of the information. The SDS shall be used only as a guide for handling the product; in the course of handling and using the product other considerations may arise or be required. Since the conditions or the handling, the storage and the disposal of this product are beyond the control of the manufacturer, the distributor or the preparer of this SDS, no warranty, expressed or implied, regarding the product described in this SDS shall be created or inferred by any statement in this SDS. No responsibility is assumed regarding the accuracy, completeness or suitability of all or any of the information contained herein or the results to be obtained from the use thereof at the time of use. In no way shall the manufacturer, the distributor or the preparer of the be liable for any claims, losses or damages of third parties, personal injury, property damage, lost profits or any special, direct, indirect, incidental, consequential or exemplary damages resulting from the use of or reliance upon such information. Users are cautioned to determine the appropriateness and applicability of the above information to their particular circumstances and purposes and assume all risk associated with the use of this product. It is the responsibility of the user to fully comply with local, national and international regulations concerning the use of this product.